Accounting for correlation of SAR images in denoising with deep learning

Proposed by : Télécom Paris

Place : Télécom Paris, 19 place Marguerite Perey, 91 120 Palaiseau

Dates : Masters internship starting from February 2020

Supervisors : Florence Tupin, (Télécom Paris, florence.tupin@telecom-paristech.fr), Loïc Denis (Télécom Saint Etienne, loic.denis@univ-st-etienne.fr), Alasdair Newson, Emanuele Dalsasso

This internship subject can possibly be extended so to pursue a PhD.

Context SAR (Synthetic Aperture Radar) data are obtained by acquiring the electromagnetic field backscattered by the ground surface. This field appears under the form of a complex number, whose module is linked to the backscattering properties of the ground surface. This imaging mode is called "coherent". It allows, by combining several images, to retrieve a 3D reconstruction or detect fine displacements (of the order of few millimeters on buildings). However, differently from the usual incoherent imagery, it leads on the images to a strong noise (called speckle) characterized by high variations of grey-levels on physically homogeneous surfaces. SAR images present several specific characteristics : the noise, from one side, and their content, from the other one, strongly influenced by the physical characteristics of the scene.

Goal of the internship Many works have been so far devoted to SAR image denoising. Several strategies have been proposed (variational approaches, patch-based methods, etc.). Most recently, deep learning algorithms have allowed to obtain promising results [1]. One of the unsolved challenges of these methods remains the correlation characterizing the speckle, which, if not properly taken into account at training time, causes the presence of artifacts in the denoised image. The goal of the internship is to train a network specifically to handle the correlation affecting SAR data. To do so, the acquisition mechanism of SAR images will be simulated [2, 3]. Learning it is expected to lead to a significant improvement of currently obtained results, as well as processing multi-temporal and polarimetric SAR images.

Internship development The internship will be prepared in the IMAGES team (Image, Modélisation, Analyse, Géométrie et Synthèse) of the IDS Department (Image, Données, Signal) of Télécom Paris, LTCI laboratory. It will be supervised by Florence Tupin, Alasdair Newson and Emanuele Dalsasso at Télécom Paris, and Loïc Denis at Télécom Saint-Etienne.

Expected knowledge and skills This topic requires good knowledge in image and signal processing and machine learning. Programming skills (Matlab/Python and/or C/C++) and familiarity with methods dealing with real data are necessary.

Références

[1] Chierchia, Giovanni, et al. "SAR image despeckling through convolutional neural networks." 2017 IEEE International Geoscience and Remote Sensing Symposium (IGARSS). IEEE, 2017.

[2] Abergel, Rémy, et al. "A complex spectrum based SAR image resampling method with restricted target sidelobes and statistics preservation." 2017 IEEE International Geoscience and Remote Sensing Symposium (IGARSS). IEEE, 2017.

[3] Abergel, Rémy, et al. "Resolution-Preserving Speckle Reduction of SAR Images : the Benefits of Speckle Decorrelation and Targets Extraction." IGARSS, 2019.